

EFFECT OF PRE-TREATMENTS AND DRYING METHODS ON MILK YAM (*Ipomoea digitata* L.) TUBER POWDER PREPARATION

SONIA. N. S.¹, JESSYKUTTY. P. C.² & SREEKALA. G. S.³

¹Research Scholar, Department of Plantation Crops and Spices, College of Agriculture Vellayani,
Kerala Agricultural University, Thrissur, Kerala, India

²Professor & Head, Department of Plantation Crops and Spices, College of Agriculture Vellayani
Kerala Agricultural University, Thrissur, Kerala, India

³Assistant Professor, Department of Plantation Crops and Spices, College of Agriculture Vellayani,
Kerala Agricultural University, Thrissur, Kerala, India

ABSTRACT

Milk yam (*Ipomoea digitata* L.), popularly called as *Ksheervidariis*, is an underutilised medicinal plant. Botanically, it is a climber having tuberous root system, is considered to be medicinal, and belongs to the family *Convolvulaceae*. It has been used by people in various parts of the world for its medicinal as well as nutraceutical potential. The present study focussed on post-harvest handling and drying techniques that can be adopted for quality milk yam tuber powder production. Peeled as well as non-peeled tubers were shredded and washed (three times, two times, single time and no washing), and de-watered by keeping in bamboo basket. These tuber shreds were dried under sun and in a hot-air oven (60°C, 70°C and 80°C). The samples were evaluated for physical and macronutrient composition. Milk yam tuber powder prepared by three times washed peeled tuber shreds dewatered by keeping in bamboo basket and dried in hot-air oven at 60°C recorded optimum physical [lowest moisture content (4.60%), moderate yield (23.27%) and drying time (12.33 hours)] and macronutrient composition [high protein (12.44 g/100g), moderate carbohydrate (50.82 g/100g) and fat (1.33 g/100g)].

KEYWORDS: Beneficial Components, *Ksheervidari*, Macronutrients & Nutraceutical

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INTRODUCTION

Ipomoea digitata L. commonly known as milk yam is a type of morning glory plant naturalized in many parts of the world belonging to the family of Sweet Potato, *Convolvulaceae*. In India, it has been noticed in the moist tropical regions like river banks, marshy areas, coastal regions etc. Milk yam grows as a perennial vine having five to seven lobed leaves, as the species name '*digitata*' suggest and bell shaped gracefully pink coloured flowers. It is having tuberous root system up to 60 cm long and 30 cm thick, weighing about 5 to 10 kg. Its tubers have been used from ancient Sanskrit times as tonic, alterative, aphrodisiac, demulcent, galactogogic and cholagogic. Only mature (bigger size) tubers of milk yam are used by Traditional Medical Practitioners (TMP) for preparing galactagogues and immunomodulatory herbal medicines (Rasayan) (Khan *et al.*, 2009).

In India, tubers of milk yam are known as Vidari and many of the Ayurvedic industries use Vidari in popular Ayurvedic nutraceutical products (Sonia *et al.*, 2017). Vidari is also an important component of the popular ayurvedic formulation *Chyavanaprasha* (Venkatasubramanian *et al.*, 2009) and used in more than 45 formulations of Ayurveda viz., Vidaryadikvatha Churna, Vidaryadi Ghrita, Marma Gutika, Manmathabhra Rasa etc. (Khan *et al.*, 2009). It is

recommended for emaciation in children and put into a compound decoction which is nutritive, diuretic, expectorant and useful in fever and bronchitis. Powdered tuber with honey is used for curing high blood pressure and heart disease. Antioxidant activity of health mix powdered were confirmed by Sonia and Jessykutty (2017).

Milk yam tubers, analogous to other edible tubers, deteriorate rapidly due to physiological changes and damages during harvesting, transportation and handling. To enhance the storage stability of milk yam tubers, it is better to convert them to dehydrated chips or flours by following specific and much the same postharvest operations followed for other edible tubers. Subsequently, it can be value added as cookies, biscuits, cakes, noodles, nutritional supplements etc. Since milk yam is rich in nutrients as well as phytochemicals, dietary supplements made out of its tubers can be included in the diet to boost overall health, energy and reduce the risks of illness and age-related conditions. It is a potential nutra-ceutical agent which is not completely explored and is a very beneficial and priority species facing extinction threats. Hence in the present study, a protocol for preparation of milk yam tuber powder was standardised which can be the preliminary operation for its value addition.

MATERIALS AND METHODS

Milk yam tubers of optimum maturity were collected from the Instructional Farm, College of Agriculture, Vellayani. The tubers were thoroughly cleaned by washing in clean water, air dried and used for experiment. The outer skin of milk yam tubers are peeled off or kept intact and shredded using a manual shredder for preparing milk yam tuber shreds. The shreds were washed in clean water and kept in a bamboo basket for dewatering. The experiment was conducted without washing the shreds also. The pre-treatments adopted are listed below.

T₁ – Peeling + Shreds washing in clean water three times + removal of excess water by keeping in bamboo baskets

T₂ – Non-peeling + Shreds washing in clean water three times + removal of excess water by keeping in bamboo baskets

T₃ - Peeling + Shreds washing in clean water two times + removal of excess water by keeping in bamboo baskets

T₄ – Non peeling + Shreds washing in clean water two times + removal of excess water by keeping in bamboo baskets

T₅ – Peeling + Shreds washing in clean water single time + removal of excess water by keeping in bamboo baskets

T₆ – Non-peeling + Shreds washing in clean water single time + removal of excess water by keeping in bamboo baskets

T₇ – Peeling + no washing

T₈ – Non-peeling + no washing

The tuber shreds are then subjected to different drying methods viz., sun drying (D1) or oven drying at different temperature conditions (D2- 60°C, D3- 70°C and D4- 80°C). For sun-drying, pre-treated milk yam tuber shreds were placed under sun light, during the period when mid-day temperature reached around 35°C. Oven drying was carried out in Labline Laboratory Oven, by placing fresh tuber shreds in oven trays and heated at required temperature conditions.

Milk yam tubers pre-treated in eight different ways were dried by adopting four different drying methods/

conditions. The experiment was conducted in a design CRD with three replications.

No: of pre-treatments the tuber underwent - 8

No: of drying methods adopted - 4

Total no: of treatments (8 x 4) - 32

The pre-treated fresh tuber shreds were dried and then powdered using a mixer grinder, sifted (50 mesh), packed in an air tight container and stored in low temperature conditions and evaluated for its physical and macronutrient composition.

Physical quality parameters viz., yield of tuber powder, moisture content and time required for drying the shreds were determined by following Ranganna (1991). Milk yam tuber powder samples were evaluated for its macronutrients viz., carbohydrate, protein and fat. These were determined using standard methods of Association of Official Analytical Chemist (2000). Analysis of Variance (ANOVA) for physical and nutritional parameters were performed in SAS statistical software. Based on superior physical and macronutrient composition, a superior pre-treatment and drying method combination sample was selected for the preparation of milk yam tuber powder.

RESULTS AND DISCUSSIONS

Drying can be applied as a cost effective processing method, and the dried product can be value added by further means (Chua and Chou, 2003). Also, quality of dried product is a measure of excellence of the methods adopted for its preparation (Fabbri and Crosby, 2016) and hence, pre-treatments are suggested (Grabowski *et al.*, 2008). Consumer acceptability and quality is usually evaluated using physical, nutritional and sensory analysis of any food product (Lawless, 1995). So, milk yam tuber powder samples were evaluated for physical and macronutrient composition and the best quality milk yam tuber powder was selected.

Effect of Pre-Treatments and Drying Methods on Physical Quality of Milk Yam Tuber Powder

Dried and powdered plant materials should have low moisture content for its improved physical quality and shelf life (Temple *et al.*, 1996). Meanwhile, time required for drying the produce depends on the moisture content of the raw material as well as the drying method adopted (Ruttarattanamongkolet *et al.*, 2016). Yield of low moisture product is also an important factor to be considered.

When the influence of pre-treatments on moisture content, drying time and yield were examined, it could be seen that pre-treatments significantly affect all the physical quality parameters (Table 1.). Milk yam tuber powder prepared using peeled tuber shreds washed for three times (T1) recorded moderate yield (21.23%), high moisture content (7.19%) and drying time (14.13 hours). Washing of tuber shreds resulted in high moisture content hence, more time was required for drying. All other samples prepared after washing the tuber shreds also recorded high moisture content, yield and drying time than the non-washed ones. High moisture content in those samples may be due to the water absorption capacity of fibers and other chemical components present in the tubers (Arias *et al.*, 2003).

When the influence of drying method on moisture content, drying time and yield were examined, it could be seen that drying methods significantly affected all the physical quality parameters of milk yam tuber powder. The tuber powder prepared by drying tuber shreds in hot air oven at 60°C (D2) recorded the lowest moisture content (6.15%), moderate

drying time (11.29 hours) and moderate yield (21.18%). It took 8 hours for drying sweet potato slices at 60°C as reported by Ruttarattanamongkolet *al.* (2016). The increased time period for drying washed milk yam tuber shreds might be due to the presence of excess moisture in it. Milk yam powder produced by sun drying (D1) recorded the highest moisture content (7.55 %), drying time (21.44 hours) as well as yield (22.94 %) whereas oven drying at 80°C (D4) recorded the lowest yield (18.52%) and drying time (6.30 hours). While sun drying, the intermittent cloud covers and rains seriously affected the samples resulted in high moisture content as in the study conducted by Seiduet *al.* (2012) on sweet potato chips and flakes. Drying at low temperature (60°C) required prolonged drying but, increasing the temperature up to 80°C is not preferable, since, it can affect the physico-chemical properties and nutritional quality of the product as reported in sweet potato slices by Marufet *al.* (2010).

There exists a positive correlation between yield and moisture content as well as moisture content and drying time. In the present study, milk yam tuber powder sample resulted in low moisture content, moderate yield and drying time was having good physical quality. Milk yam tuber powder having lowest moisture content (4.60%) was obtained by drying the peeled and three times washed tuber shreds in hot air oven at 60°C (T1D2). This sample took moderate time period (12.33 hours) for drying and recorded a moderate yield (23.27%). At the same time, tuber powder prepared using non-peeled tuber shreds washed for three times and dried under sun (T2D1) recorded highest moisture content (10.20%), drying time (23.67 hours) and yield (26.23%). This is in agreement with the findings of Olatundeet *al.* (2016) who had reported that pre-treatments like soaking in water, potassium metabisulphite solution as well as blanching and its interaction with drying methods viz., sun drying and oven drying (50°C) had significant effect on the moisture content of sweet potato flour and it ranges from 8.06 – 12.86%.

Hence, in the present study peeled tuber shreds washed for three times, de-watered by keeping in bamboo basket and dried in hot-air oven at 60°C (T1D2) yielded milk yam tuber powder with superior physical quality attributes.

Effect of Pre-treatments and Drying Methods on Nutritional Quality of Milk Yam Tuber Powder

Macronutrient Composition of Milk Yam Tuber Powder

Macronutrients are carbohydrate, protein and fat. Carbohydrate is the richest nutrient in the tubers, it contributes the bulk of flour and serves as good energy source (Woolfe, 1992). Protein is a highly essential nutrient that carry out a wide range of life processes (NIN, 2009). Tubers are generally low in fat and only 1-2% calorie in the form of fat is sufficient for human beings (NIN, 2009). Fats from plant sources are easily digestable by the human body hence, its consumption should be encouraged (Antiaet *al.*, 2006).

Pre-treatments applied to milk yam tuber shreds significantly influenced carbohydrate and protein content but not the fat content of the tuber powder (Table 2.). Carbohydrate content was maximum (60.47 g/100g) for non-peeled and non-washed tuber shreds (T8). All tuber shreds underwent washing recorded low carbohydrate content indicating the leaching loss of soluble carbohydrates. This is in accordance with the findings of Olatundeet *al.* (2016) who prepared sweet potato flour by pre-treating the samples by soaking in water for forty five minutes (74.55-90.92 g/100g). Regarding protein content, milk yam tuber powder prepared using two times washed peeled milk yam tuber shreds (T3) recorded the maximum (9.5 g/100g) which was on par with the non-peeled and non-washed ones (T8-8.58 g/100g). Three times washed peeled tuber shreds (T1) when dried and powdered recorded moderate protein content (8.45 g/100g). This imply, washing more than two times resulted protein loss too. Even though T1 recorded moderate protein content it is higher than that of dried sweet potato powder (0.55 – 5.87 g/100g; Olatundeet *al.*, 2016) and tapioca powder (1.30 – 2.56 g/100g;

Oghenechavavwukoet *al.*, 2013). Washing didn't make any significant difference in fat content of milk yam tuber powder which might be due to the proven fact that fats are in-soluble in water.

Drying methods adopted also had significant effect on carbohydrate and protein but no influence on fat content. Maximum carbohydrate and protein content were recorded by samples dried in hot air-oven at 60°C (D2), 57.07 g/100g and 11.63 g/100g respectively. Sun drying (D1) as well as oven drying at 70°C (D3) and 80°C (D4) resulted a low value for both carbohydrate and protein content. This agrees with the findings of Olatundeet *al.* (2016) who reported that sun dried sweet potato flour had lower carbohydrate (starch) content (55.76 – 78.45%) than oven dried (50°C) flour (56.38 – 79.55%). Carbohydrates, particularly starch, might be converted to dextrin. On the other hand proteins, particularly lysine, underwent destruction when it interacted with carbohydrate at high temperature (Walter *et al.*, 1975). This is also in accordance with the findings of Grabowski *et al.* (2008) in spray dried sweet potato flour. This suggests that other drying methods are inferior to oven drying at 60°C (D2).

Seiduet *al.* (2012) reported that good quality sweet potato flour had low moisture (8.50%) and high protein content (4.04 g/100g). For milk yam, good quality tuber powder having high protein content (12.44 g/100g) and low moisture content (6.29%), was obtained by drying three times washed peeled tuber shreds, dewatered by keeping in bamboo basket and dried in hot-air oven at 60°C (T1D2). Besides, T1D2 recorded moderate carbohydrate (50.82 g/100g) and fat content (1.33 g/100g). Milk yam tuber shreds pre-treated in the same way and dried in hot-air oven at 80°C recorded least carbohydrate (41.81 g/100g) as well as protein (6.25 g/100g), which might be due to the thermal degradation. Fat content of milk yam tuber powder ranges from 1.15-1.49 g/100g. All the tuber powder samples recorded a low fat content which is in agreement with the findings of Abubakaret *al.* (2010) on different sweet potato dishes. Low carbohydrate-low fat diet has an established record of safety and efficacy. Also, low calorie-high protein diet has potential impact on reducing cardio-vascular risk parameters (Kappagoda and Amsterdam, 2004).

On this account, in the present study, milk yam tuber powder having optimum macronutrient composition viz., high protein, moderate carbohydrate and fat was prepared by drying three times washed peeled tuber shreds in hot-air oven at 60°C (T1D2).

CONCLUSIONS

Milk yam remains underutilised if its potential is not completely explored. For its utilisation, it is necessary to develop appropriate postharvest handling procedures. The preliminary, cheap and easy way of value addition for milk yam is drying, since the tubers are high in moisture and easily perishable. In the present study, milk yam tubers were peeled and shredded washed for three times, dewatered by keeping in bamboo basket and dried in hot-air oven and powdered to produce good quality power. This has got superior physical and macronutrient composition. This study sustained the fact that a wide scope for research exists with milk yam powder, like development of dietary supplement, bakery products, nutraceuticals etc. since it is both nutritional as well as medicinal.

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Table 1. Physical Quality Parameters of Dried and Powdered Milk Yam Tubers

Yield (%)						Moisture (%)						Drying time (Hours)					
	D1	D2	D3	D4	Mean		D1	D2	D3	D4	Mean		D1	D2	D3	D4	Mean
T1	26.57	23.27	21.40	21.40	21.23	T1	7.85	4.60	7.60	8.70	7.19	T1	26.50	12.33	9.67	8.00	14.13
T2	26.23	21.23	21.50	22.90	23.16	T2	10.20	5.47	7.20	7.96	7.71	T2	23.67	13.00	9.67	8.00	13.59
T3	21.83	22.03	21.43	17.30	22.97	T3	7.13	7.77	6.97	7.43	7.33	T3	21.33	12.00	9.33	6.67	12.33
T4	21.70	21.67	22.33	18.23	20.98	T4	7.70	7.60	6.50	6.67	7.12	T4	22.67	12.00	9.00	6.33	12.50
T5	22.40	21.23	21.47	19.43	21.13	T5	8.37	6.30	6.93	7.30	7.23	T5	20.33	11.66	8.33	5.67	11.50
T6	22.87	22.47	20.67	18.90	20.65	T6	7.83	6.90	6.27	8.07	7.27	T6	22.33	11.33	8.67	5.67	12.00
T7	20.53	18.3	19.43	15.17	18.36	T7	5.70	5.33	5.10	5.87	5.50	T7	19.33	9.00	7.33	5.00	10.17
T8	21.37	19.23	19.57	14.83	18.75	T8	5.63	5.23	4.60	6.03	5.37	T8	15.33	9.00	7.67	5.00	9.25
Mean	22.94	21.18	20.98	18.52		Mean	7.55	6.15	6.40	7.25		Mean	21.44	11.29	8.71	6.30	
Treatments	SEm(±)				CD	Treatments	SEm(±)				CD	Treatments	SEm(±)				CD
Pre-treatment	0.36				1.017	Pre-treatment	0.31				0.872	Pre-treatment	0.48				1.369
Drying	0.26				0.715	Drying	0.22				0.614	Drying	0.34				0.964
Pre-treatment x Drying	0.72				2.029	Pre-treatment x Drying	0.61				1.742	Pre-treatment x Drying	0.96				2.733

Table 2. Macronutrient Composition of 100 G Dried and Powdered Milk Yam Tubers

Carbohydrate (g/100g)						Protein (g/100g)						Fat (g/100g)					
	D1	D2	D3	D4	Mean		D1	D2	D3	D4	Mean		D1	D2	D3	D4	Mean
T1	47.64	50.82	42.90	41.81	45.79	T1	7.42	12.44	7.68	6.25	8.45	T1	1.25	1.33	1.31	1.21	1.27
T2	48.57	51.61	43.43	42.20	46.45	T2	7.87	11.79	7.61	5.64	8.23	T2	1.43	1.29	1.21	1.23	1.29
T3	49.27	53.24	45.69	43.83	48.01	T3	9.44	12.95	7.29	8.31	9.50	T3	1.45	1.40	1.25	1.34	1.36
T4	52.38	58.57	47.53	44.38	50.72	T4	8.42	11.51	8.30	7.00	8.81	T4	1.49	1.33	1.23	1.27	1.33
T5	51.91	55.59	51.16	51.11	52.44	T5	8.33	11.59	6.87	9.06	8.96	T5	1.31	1.32	1.25	1.43	1.33
T6	53.43	62.44	58.65	58.09	58.15	T6	8.14	10.33	6.54	8.61	8.41	T6	1.25	1.29	1.43	1.33	1.33
T7	52.19	60.09	59.61	58.81	57.67	T7	9.07	10.94	6.47	8.67	8.79	T7	1.29	1.30	1.29	1.15	1.26
T8	54.79	64.17	61.82	61.10	60.47	T8	8.62	11.46	6.33	7.91	8.58	T8	1.21	1.26	1.27	1.36	1.28
Mean	51.27	57.07	51.35	50.16		Mean	8.41	11.63	7.14	7.68		Mean	1.34	1.32	1.28	1.29	
Treatments	SEm(±)		CD			Treatments	SEm(±)		CD			Treatments	SEm(±)		CD		
Pre-treatment	0.70		1.976			Pre-treatment	0.31		0.877			Pre-treatment	0.04		NS		
Drying	0.49		1.391			Drying	0.22		0.617			Drying	0.03		NS		
Pre-treatment xDrying	1.39		3.945			Pre-treatment xDrying	0.62		1.752			Pre-treatment xDrying	0.08		NS		